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(71) Applicant

NHK Spring Co Ltd (Japan),  
1 Shinisogo-cho, Isogo-ku, Yokohama-shi, Japan

(72) Inventor

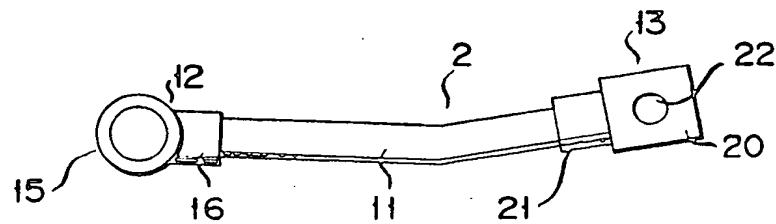
Akihiko Nishikawa

(74) Agent and/or Address for Service

A A Thornton & Co,  
Northumberland House, 303/306 High Holborn,  
London WC1V 7LE

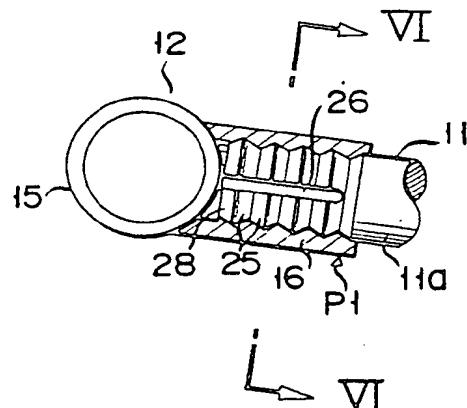
(54) Axle supporting rod for motor vehicle

F I G. 3



(57) A steel rod body (11) is fixedly fitted, at its end, with a metallic coupling member (12) manufactured independently of the rod body (11). A solid section (11a) having a free end is formed either at the end of the rod body (11) or the coupling member (12), while a tube section (16) having an opening at its end is provided on the corresponding end of either the rod body or the coupling member. Circumferential and axial grooves (25, 26) are formed on the outer peripheral surface of the solid section (11a). At least the free end of the solid section (11a) is inserted into the opening of the tube section (16), and the tube section (16) is crimped by means of dies. Thus, part of the metal material of the tube section (16) creeps into indentations (25, 26) on the solid section (11a) so that the tube section (16) and the solid section (11a) are firmly linked together for integration.

F I G. 4

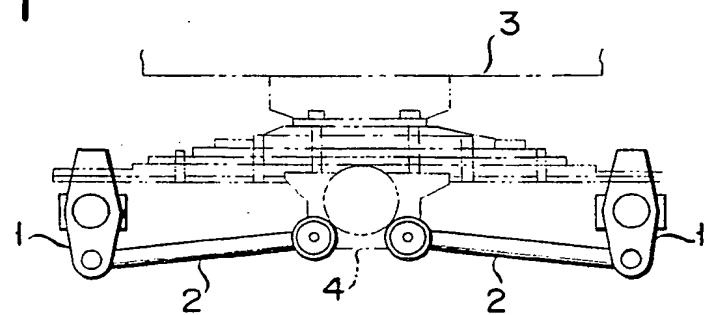


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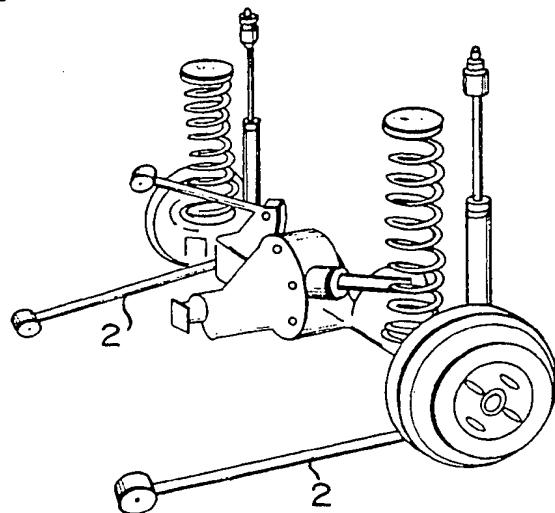
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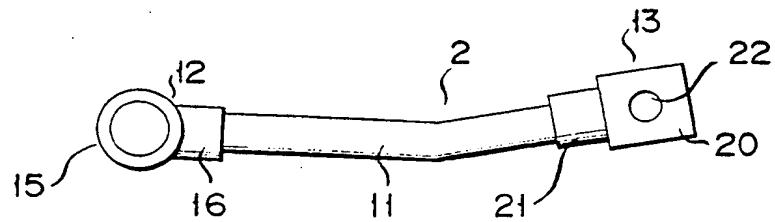
F I G. 1



F I G. 2



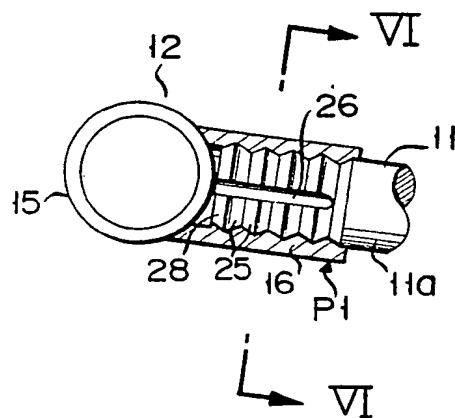
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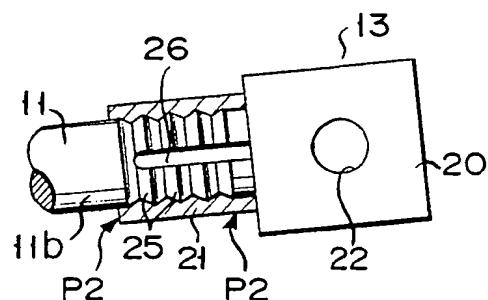
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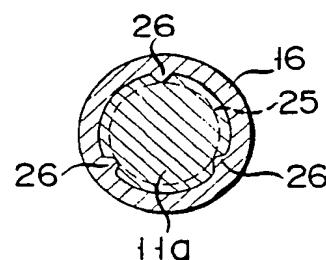
F I G. 4



F I G. 5



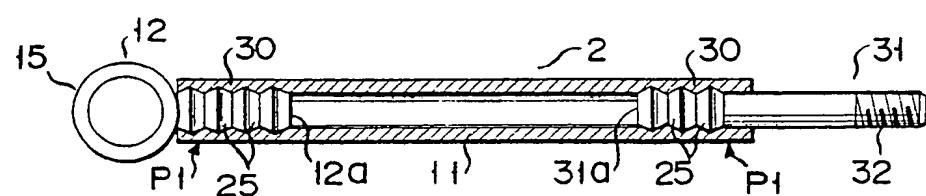
F I G. 6



F I G. 7



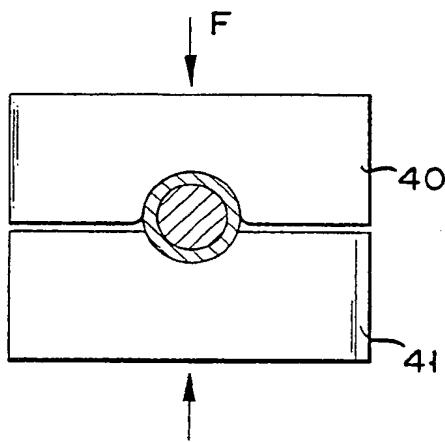
F I G. 8



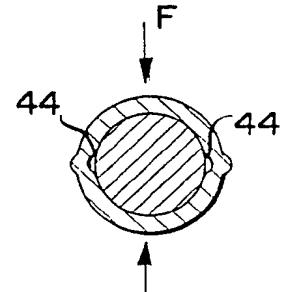
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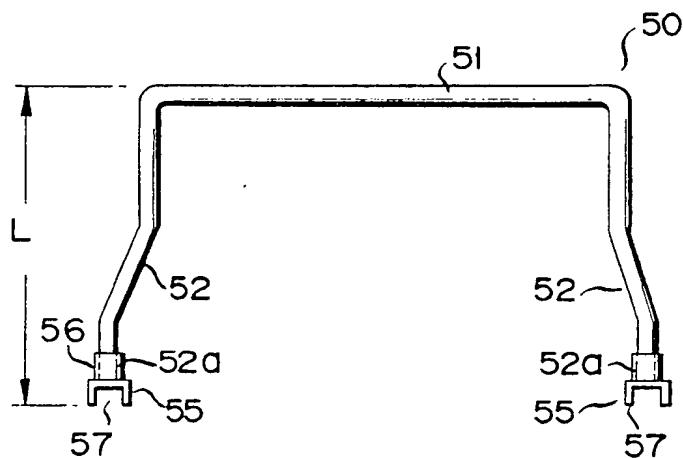
F I G. 9



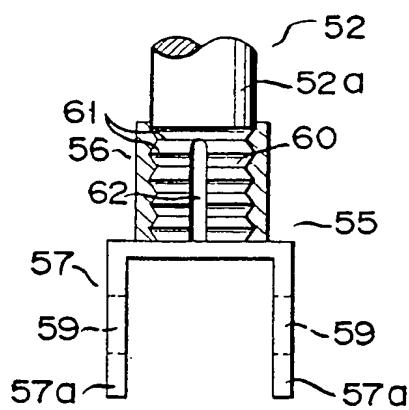
F I G. 10



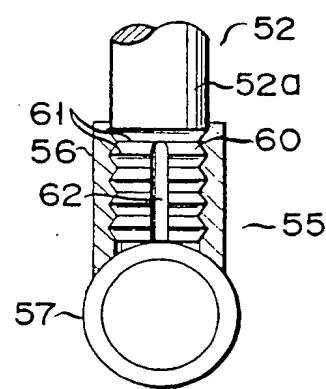
F I G. 11



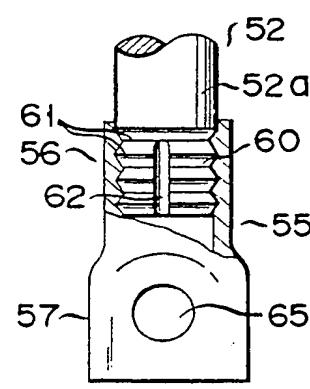
F I G. 12



F I G. 13



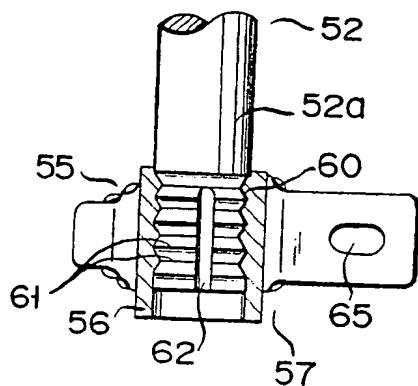
F I G. 14



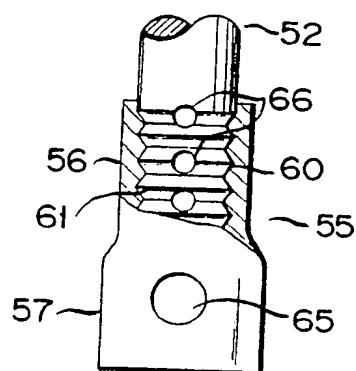
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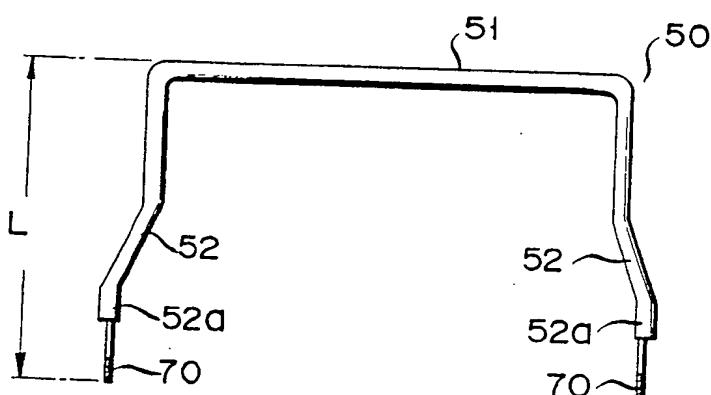
F I G. 15



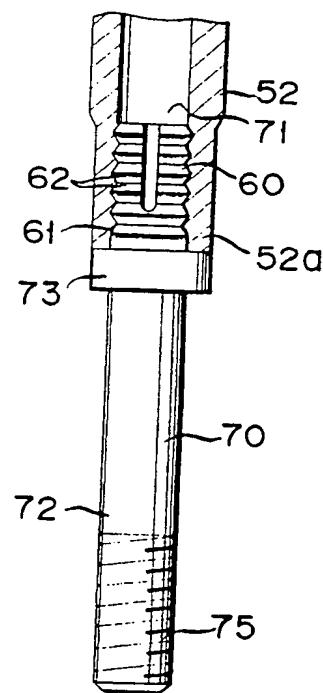
F I G. 16



F I G. 17



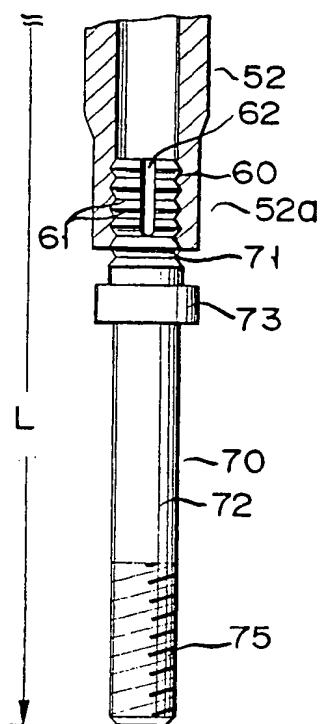
F I G. 18



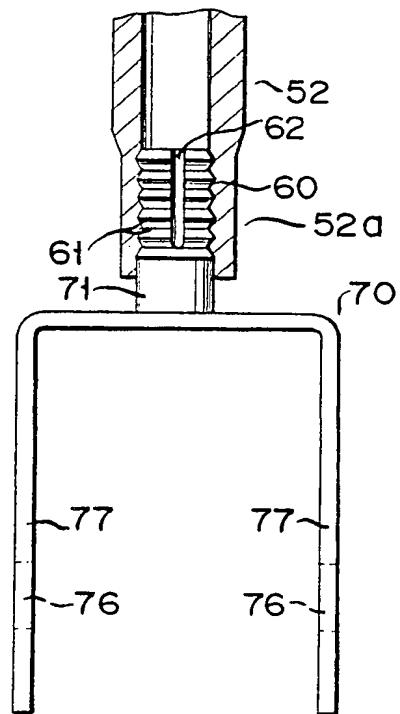
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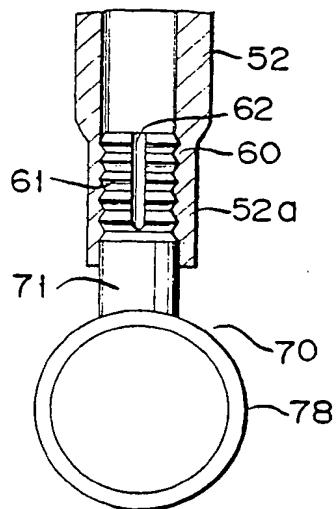
F I G. 19



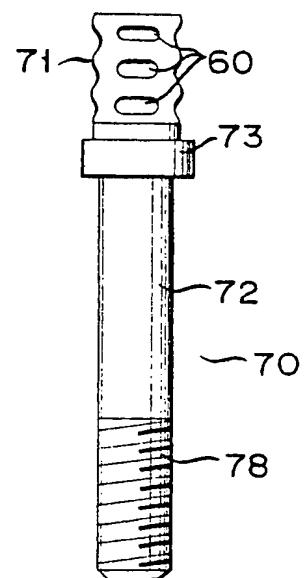
F I G. 20



F I G. 21



F I G. 22



## SPECIFICATION

### Axle supporting rod for motor vehicle

5 The present invention relates to axle supporting rods, such as radius rods and stabilizers, used in suspension systems of motor vehicles.

Stabilizers are generally used as a type of axle supporting rods for stabilizing the posture 10 of the body of motor vehicles in rolling motion.

A conventional stabilizer is a rod bent in a predetermined shape, and consisting of a torsion section and a pair of arm sections extending 15 the ends of the torsion section. When used in a motor vehicle, the torsion section is positioned extending in the transverse direction of the vehicle, while the arm sections are coupled at their free ends to a pair of suspension 20 systems of the vehicle.

In a typical prior art example, the free ends of the arm sections are flattened and have a fitting hole.

The ends of the conventional stabilizer can 25 be shaped with relative ease by forging or the like. In a stabilizer of this type, however, the ends are restricted to a uniform shape and cannot be varied. Therefore, the stabilizer is not adaptable to a variety of suspension systems.

In a prior art stabilizer of another type, coupling members, manufactured independently of the arm sections, are welded to the end of the arm sections. Although this stabilizer 35 can be fitted with coupling members of various shapes, it is subject to the following drawbacks.

In welding the coupling members to the arm sections, rapid heating or cooling of 40 welds will cause various malfunctions. In order to avoid this, it is absolutely necessary to perform both preheating and postheating before and after welding. Thus, welding the coupling members requires many processes 45 and facilities, resulting in an increase in cost.

These days, in particular, stabilizers tend to be used under severe stress conditions. Accordingly, spring steel with a high carbon equivalent is commonly used as a material for 50 the stabilizers. Welding the spring steel, however, involves several problems. The aforesaid preheating and postheating would, for example, require precise control of temperature and time.

55 Stabilizers of yet another type have a function as tension rods, in addition to their primary function as stabilizers.

The body of stabilizers of this type is subjected to tension on its arm sections, as well 60 as both bending and torsional moment. Each arm section has a thread formed at its end whereby the arm section is coupled to the suspension system.

Stabilizers these days tend to be hollow for 65 reduced motor vehicle weight and economy of

resources. Hollow stabilizers, however, have not yet been put to practical use as stabilizers doubling as tension rods. One of the reasons for this is that even though pipes can be used

70 for the torsion section and arm sections in view of their mechanical strength, no effective or reliable coupling means for connecting the stabilizer body and the coupling members at the ends of the body has yet been developed.

75 In a prior art system stated in Japanese Utility Model Publication No. 55-153207, solid coupling members are fixed to a hollow stabilizer body by fitting the former into the ends of the latter. In this case, however, the 80 coupling members are limited in fixing strength and are not very high in reliability.

Accordingly, conventional stabilizers are integrally formed from a solid material, having thread portions at their ends. In this case, 85 however, the stabilizer body is heavy in weight. Also, the stabilizer body and the thread portions are integral with one another so that it is difficult to form the thread by rolling. Thus, threading inevitably requires 90 cutting work, resulting in increased cost.

The stabilizer doubling as a tension rod is expected to have an accurate length in the longitudinal direction of the motor vehicle. If the stabilizer body is formed integrally with 95 the threaded portions, however, it is impossible to correct distortion caused by heat treatment. It is, therefore, difficult for the stabilizer body to have specified dimensions.

Prior art radius rods will now be described. 100 Radius rods are rods which serve to determine the longitudinal position of an axle, and to counter torque produced at the time of acceleration or deceleration of a motor vehicle (see JASO 3006). Thus, the radius rods are a kind of axle supporting rod used in suspension systems.

Most of the prior art radius rods are straight and low in working stress. Conventionally, therefore, carbon steel for mechanical structures (equivalent to S30C provided by Japanese Industrial Standards), or other low-carbon steel is frequently used as a material for the radius rods. Where low-carbon steel is used for radius rods, the rod-shaped radius 110 rod body can be welded to the coupling members without any problem.

Recently, however, there has been an increasing demand for radius rods whose bodies are partially bent for reasons of accomodating 120 the layout of particular suspension systems.

Radius rods of this type are used under severer stress conditions than straight radius rods. Consequently, the use of low-carbon steel for their material provides insufficient 125 strength. Thus, it is necessary to use spring steel to form the radius rod, treating the spring steel with heat for higher tensile strength.

However, because of its high carbon equivalent, the spring steel cannot easily be

integration. The coupling member 31 is rod-shaped and has a thread 32 at its extreme end.

Thus, as in previous embodiments, the embodiment of Fig. 8, the coupling members 12 and 31 can be firmly fixed. Moreover, the radius rod 2 shown in Fig. 8 is light in weight because its body 11 is hollow.

The crimping or plastic processing is performed using a pair of dies 40 and 41, as shown in Fig. 9. Since the crimping load is generally applied in one direction, some gaps 44 will inevitably be formed in a cross section perpendicular to the loading direction F, as shown in Fig. 10.

The gaps 44 permit penetration of external liquids. If water or other liquids corrosive to metal penetrates the gaps, the inside of the crimped portions may possibly rust.

To prevent rusting, it is advisable to fill the inside of the crimped portions with a sealant. This sealant is applied to at least one of the indentations 25 before the plastic processing so as to cover its entire circumferential length. After the application of the sealant, load is exerted on the dies 40 and 41 to thereby link the tube sections and the solid portions together.

Pasty synthetic rubber is suitable for use as the sealant, although other materials may also be used. Regions to be coated with the sealant are indicated by arrow P1 in Figs. 4 and 8. In the example of Fig. 5, the sealant is applied to two ends, as indicated by arrow P2. In short, the sealant is applied to regions wherein liquids might penetrate such that liquid can be prevented from penetrating.

As shown in Fig. 10, the gaps 44 tend to be narrowest in the loading direction (indicated by arrow F), and widest in the direction perpendicular to the loading direction. During the crimping, therefore, the sealant, uniformly applied in the circumferential direction before the crushing, flows so that it is thin in the loading direction, filling up the gaps in a direction perpendicular to the loading direction. Thus, the sealant effectively fills the widest gaps to prevent penetration of liquid, providing a rust preventive.

Despite the use of the sealant, the crimped regions still permit contact between the metal materials, thereby ensuring sufficient bonding strength.

Further embodiments of the present invention applied to solid stabilizers will now be described.

The embodiment of Fig. 11, uses a stabilizer body 50. Like a conventional stabilizer body, the body consists of a torsion section 51 and a pair of arm sections 52 connected to the ends of the torsion section 51.

The stabilizer body 51 is formed by bending a metallic solid material, such as spring steel. Thus, the torsion section 51 and the arm sections 52 are solid members. Each arm

section 52 has a free end. Two coupling members 55 are connected to the ends 52a of the arm sections 52.

Each coupling member 55 includes a tube section 56 to receive the end 52a of each corresponding arm section 52, and a distal section 57 continuous with the tube section 56. The end of the tube section 56 is open.

Both the tube section 56 and the distal section 57 are made of a metal such as steel. In this embodiment, the distal section 57 is fixed to the tube section 56 by welding. Alternatively, however, the tube section 56 and the distal section 57 may be fixed to each other by any means other than welding, or may be formed integrally.

In an example shown in Fig. 12, the distal section 57 has substantially a U-shaped side view. A pair of legs 57a, facing each other, are each formed with a fitting hole 59. A bolt or other coupling means is inserted into each fitting hole 59 and fixed to the suspension system side.

Meanwhile, indentations 60 are formed beforehand on the outer peripheral surface of the end 52a of the arm section 52. In this embodiment, the indentations 60 include a plurality of circumferential first grooves 61 formed by rolling, and an axial second groove 62. The grooves 61 and 62 are shaped like shallow V-notches in the section.

After the end portion 52a is inserted into the tube section 56, the tube section 56 is diametrically crimped, reducing its diameter.

Thus, the coupling member 55 is linked to the end 52a of the arm section 52 for integration.

According to the arrangement described above, the length of the arm section 52, i.e., the span L in the longitudinal direction of the motor vehicle, can be adjusted by controlling the relative axial position of the coupling member 55 before crimping the tube section 56. Thus, it is possible to deal with distortion of the stabilizer body 50 which may be caused by heat treatment.

Fig. 13 shows a stabilizer according to another embodiment of the invention. A distal section 57 of a coupling member 55 of the embodiment is a cylinder extending at right angles to the tube section 56. As regards other components and functions, this stabilizer is similar to the stabilizer described in connection with Figs. 11 and 12. In Fig. 13, therefore, like reference numerals are used to designate like portions shown in Figs. 11 and 12.

A coupling member 55 of a stabilizer, shown in Fig. 14, is integrally formed from a cylindrical material. The lower half, as illustrated, of a cylindrical metal material is crushed to form a flat distal section 57, leaving a tube section 56 at the upper half portion. The distal section 57 is formed with a fitting hole 65.

In a coupling member 55 according to still another embodiment shown in Fig. 15, a distal section 57 formed by bending a metal plate is fixed to the outer peripheral surface of 5 a tube section 56. The distal section 57 is formed with a fitting hole 65.

In a further embodiment shown in Fig. 16, a plurality of circular, oblong or elliptical indentations 66 are formed in place of the axial 10 grooves.

As is evident from the embodiments described above, the indentations 60 are not limited to grooves. It is necessary only that the indentations 60 be able to receive part of 15 the metal of the tube sections 56, lest the coupling members 55 rotate relative to the corresponding arm sections 52 of the stabilizer body 50, and slip off in the axial direction thereof.

20 Referring now to Figs. 17 to 22, further embodiments of the present invention applied to hollow stabilizers will be described.

A stabilizer body 50, shown in Fig. 17, is formed by bending a metallic pipe, such as 25 resistance-welded pipe, into a predetermined shape. A seamless pipe or other steel pipe may also be used as a material for the stabilizer body 50.

30 A coupling member 70 made of steel or other metallic solid material is fixed to an end 52a of the arm section 52. The arm section 52 has an opening at its end 52a, thus constituting a tube section.

35 Each coupling member 70 includes a solid rod-shaped portion 71 for insertion into the end 52a of its corresponding arm section 52, a shaft 72 extending coaxial with the rod-shaped portion 71, and a collar 73 located between the shaft 72 and the rod-shaped 40 portion 71. The rod-shaped portion 71 has a free end. A thread 75 is formed at the distal end of the shaft 72. The thread 75 is coupled to a suspension system (not shown).

45 Indentations 60 are formed beforehand on the outer peripheral surface of the rod-shaped portion 71 by, for example, rolling. The indentations 60 include a plurality of grooves 61 extending in the circumferential direction of the rod-shaped portion 71, and a groove or 50 grooves 62 extending in the axial direction of the rod-shaped portion 71. It is to be understood that the grooves 61 and 62 may be somewhat inclined against the circumferential or axial direction of the rod-shaped portion 55 71.

55 After at least the free end of the rod-shaped portion 71 is inserted into the end 52a of the arm section 52, the end 52a is diametrically crimped by means of dies, as in the case of 60 the embodiment shown in Fig. 9; Thus, the coupling member 70 is fixed to the arm section 52.

In the hollow stabilizer of this construction, as shown in Fig. 19, that portion of the rod-shaped portion 71 for the indentations 60 is

designed to be sufficiently long so that the span L in the longitudinal direction of the motor vehicle can be adjusted by changing the axial position of the coupling member 70

70 relative to the end 52a, before crimping the end 52a. This arrangement is particularly effective for those stabilizers doubling as a torsion rod.

Moreover, since the coupling member 70 and the stabilizer body 50 can be formed independently, the threading 75 at the distal end of the coupling member 70 can be formed by rolling, permitting a reduction in manufacturing cost.

80 Also, the threading 75 can undergo rust-proof treatment. In the case of the prior art solid stabilizers, even if the thread portions were previously coated with rustproof film, subsequent heat treatment caused the film to peel off. According to the aforementioned hollow stabilizer, however, the stabilizer body 50 and the coupling member 70 can be separately treated with heat so that the threading 75 may previously be treated for 85 rust prevention by, for example, plating.

Since the stabilizer body 50 is hollow, the stabilizer of this embodiment is lighter in weight than the conventional solid stabilizers.

It is to be understood that the present 95 invention may also be applied to regular stabilizers without having the function as a tension rod. Figs. 20 and 21 show examples of such stabilizers.

A coupling member 70 of the embodiment 100 shown in Fig. 20 has forked legs 77. The coupling member 70 is connected to the suspension system side by means of fitting holes 76 formed individually in the legs 77.

A coupling member 70 shown in Fig. 21 105 has a tubular distal section 78. The coupling member 70 is connected to the suspension system side by means of the distal section 78. As regards other basic arrangements, the stabilizer of this embodiment is similar to the 110 hollow stabilizer shown in Fig. 18, providing the same functions and effects.

Fig. 22 shows an example in which hemispherical, oblong or elliptical indentations 60 are formed in place of the grooves.

115 In any of the stabilizers described above a sealant may be provided, as in the case of the radius rods, between the crushed regions of the tube sections and the solid portions.

## 120 CLAIMS

1. An axle supporting rod for a motor vehicle comprising a metallic rod body and a metallic coupling member formed independently of and fixed to the end of the rod body,

125 further comprising:

a solid section formed either at the end of the rod body or at the end of the coupling member, and having a free end and, on its outer periphery, indentations;

130 a tube section formed either at the end of

- the rod body or the end of the coupling member, having an opening at the end portion thereof; and  
wherein at least the free end of the solid section is inserted into the opening of the tube section, and the tube section is crimped so that part of the tube section protrudes into the indentations to thereby link the tube section and the solid section together for integration.
2. An axle supporting rod for a motor vehicle according to claim 1, wherein said indentations include a plurality of grooves extending in the circumferential direction of the solid section.
3. An axle supporting rod for a motor vehicle according to claim 2, wherein said solid section is formed with at least one of axially extending grooves on the outer peripheral surface thereof.
4. An axle supporting rod for a motor vehicle according to claim 3, wherein the material of said tube section is a resistance-welded pipe having an inner surface upon which an axially extending bead weld is formed.
5. An axle supporting rod for a motor vehicle according to claim 4, wherein said bead weld is arranged along the axially extending groove.
6. An axle supporting rod for a motor vehicle according to any one of claims 1 to 5, wherein spring steel is used as a material for the rod body.
7. An axle supporting rod for a motor vehicle according to any one of claims 1 to 6, wherein said rod body includes a torsion section extending in the transverse direction of the motor vehicle, and a pair of arm sections continuous with each end of the torsion section so as to extend in the longitudinal direction of the motor vehicle, said torsion section and said arm sections being hollow.
8. An axle supporting rod for a motor vehicle according to claim 7, wherein said coupling member is formed with a rod-shaped shaft having a thread thereon.
9. An axle supporting rod for a motor vehicle according to claim 8, wherein a waterproof sealant is provided between said tube section and said solid section.
10. An axle supporting rod for a motor vehicle, substantially as hereinbefore described with reference to the accompanying drawings.